

MEDICAL PRACTICE

*Clinical Topics***Tennis elbow: conservative, surgical, and manipulative treatment**

THOMAS G WADSWORTH

My first case was rather dramatic. The patient was a big strong man and I insisted on an anaesthetic. Under nitrous oxide I wrenched the arm as follows: with the wrist and fingers flexed and the forearm fully pronated I forced the elbow into hyperextension, making at the same time firm pressure with my left thumb over the tender spot by the external epicondyle. There was a snap like a pistol shot and the horrified anaesthetist insisted that I had broken the arm. The cure was as dramatic as the manipulation.¹

Tennis elbow is one of the commonest lesions of the arm and was first described by Runge in 1873.² Typically the patient complains of lateral elbow pain that is aggravated by gripping. Symptoms commonly interfere with activities of daily living, leisure pursuits, and work. Allander found an incidence of 1-3% in a population study of 15 000 subjects, the proportion varying in different groups.³ Gruchow and Pelletier investigated 500 tennis players (278 men and 254 women); the incidence of tennis elbow was 39.7%.⁴ The lesion was severe in 24% of patients aged under 50 and in 42% over this age; women were more commonly affected in the older group. Kivi found the syndrome in 88 out of 7600 manual workers (50 men and 38 women); in 54 it was thought to be due to overexertion of finger and wrist extensors in trained workers.

In most patients aged over 30 the condition may be considered to be a degenerative process, the onset of symptoms being hastened by overuse of the arm. In tennis players the incidence and rate of recurrence increase with the age of the player, and the amount of daily playing time is also a contributing factor; the grip size of the racquet may also have a role, particularly in older players. Some people believe that the increased incidence of tennis elbow in players is directly attributable to the materials from which modern racquets are made. With wooden racquets vibrations that occur

when the ball is hit tend to be absorbed, but modern racquets, which are made from metal, graphite, and fibreglass, do not absorb vibrations so effectively. Some manufacturers are trying to produce racquets that will lessen the likelihood of damaging the elbow: a combination of carbon and graphite fibre or aramid fibre embedded in epoxy resin and run around a light hardfoam core is being used, the core taking over the important function of damping vibrations.

The dominant arm is affected in most cases and the condition is bilateral in a few; black people are rarely affected. In clinical practice the condition is found more often in non-athletes than athletes; probably less than 5% of patients with epicondylitis are golf or tennis players. Tennis elbow—lateral epicondylitis—is far more common than medial epicondylitis, so called “golfers’ elbow.”

Pathology

Tennis elbow sometimes serves as a blanket term for every pathological condition of the lateral compartment of the elbow causing pain, including arthritis of the radiohumeral articulation. These have included chronic impingement of a synovial fringe between the radial head and the capitulum; stress on the orbicular ligament; bursitis; strain of the lateral ligament; degenerative changes in the orbicular ligament; the radial tunnel syndrome; compression of the posterior interosseous nerve; fibrillation of the radial head; ectopic calcification; and reflex localisation of pain from radiculopathy at the cervical spine.⁶⁻¹²

Many conditions have been postulated as causing tennis elbow, but in most cases the lesion involves the specialised junctional tissue at the origin of the common extensor muscle at the lateral humeral epicondyle, specifically the tendonous origin of extensor carpi radialis brevis.¹³ The lesion is characterised by macroscopic and microscopic tears, which may be superficial or deep and situated at the tendonous origin of extensor carpi radialis brevis into the periosteum of the lateral humeral epicondyle. Microavulsion fractures may be seen as well as round cell infiltration, scattered foci of fine calcification, and scar tissue with marginal areas of cystic degeneration, and fibrinoid degeneration may be evident in some cases; repair is by immature reparative tissue. These findings indicate rupture of the tendon.¹³⁻¹⁶

Typically, repetitive and cumulative injury produces the pathological changes: force overload may be intrinsic, by muscle contraction, or

extrinsic, by traumatic overstretching; occasionally, the cause is direct trauma. Nirschl and Pettrone found that half of tennis players over the age of 30 had tennis elbow; in half of these the problem was minor, with symptoms lasting less than six months, and in the remainder the symptoms lasted for an average of two and a half years.¹⁶ In patients with chronic symptoms the problem is probably associated with inadequate muscle power and endurance, together with increased age, when strain or rupture of the proximal tendinous origin of the extensor carpi radialis brevis can more readily occur. Thus either the condition resolves spontaneously, particularly if the arm is rested for several weeks, or the symptoms persist, in some cases indefinitely.

Clinical features

The patient is likely to be an adult aged 20-50, most being over 30. The dominant arm is usually affected, but the condition is occasionally bilateral. Men are more likely to suffer than women. Pain, of sudden or gradual onset, is localised to the outer aspect of the elbow and is aggravated by gripping and heavy use of the arm and even by such simple tasks as carrying a shopping bag. Activity may be severely restricted, not only in heavy manual workers but in office typists and other sedentary workers; leisure activities may also be affected. Tenderness is typically localised to the tendinous origin of the extensor carpi radialis brevis at the lateral humeral epicondyle.

The forced elbow extension test usually yields a positive result. The forearm is held fully pronated and the wrist palmar flexed: passive elbow extension then produces lateral elbow pain, which may limit full extension of the joint (fig 1). Several signs are pathognomonic of tennis elbow. When

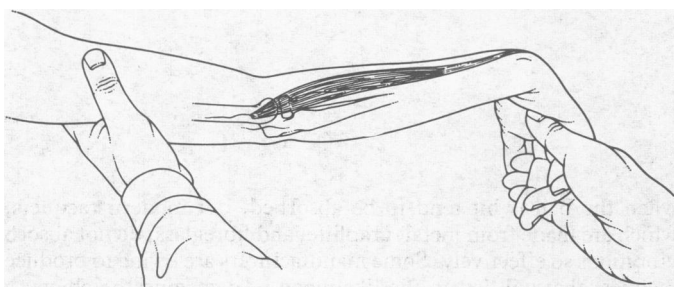


FIG 1—Forced elbow extension test.

asked to grip and lift an object such as a chair the patient experiences pain laterally at the elbow. Extending the fingers and wrist against resistance or, better still, resisted wrist extension with the fingers gently clenched will also produce lateral elbow pain, as will resisted radial deviation of the hand (fig 2). Another sign is lateral elbow pain produced by resisted extension of the middle finger, emphasised with the elbow in full extension. Diminished grip pressure may be observed, probably due to voluntary diminution of effort to avoid undue pain.

Elbow radiographs are usually normal, but lateral ectopic calcification is occasionally present. Radiographs should be obtained to eliminate the possibility of arthritic change at the radiohumeral articulation. Arthroscopic examination of the joint may prove valuable in cases resistant to conservative measures and caused by minor arthritic problems such as fibrillation of the radial head. Tennis elbow may be part of a generalised arthropathy; if there

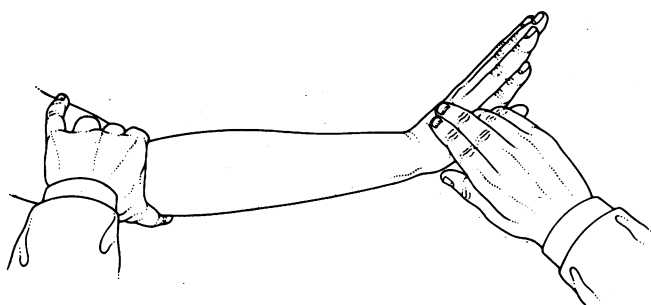


FIG 2—Resisted wrist extension test.

are additional joint symptoms other investigations should be carried out, including measurement of erythrocyte sedimentation rate and uric acid concentration, tests for rheumatoid disease, and full blood count.

Differential diagnosis

Arthritis of the elbow and proximal radioulnar joints is usually obvious and most often rheumatoid or post-traumatic in nature. Routine radiography defines whether lateral elbow pain is due to arthritis or ectopic calcification. Confusion arises when tennis elbow coexists with other painful conditions in the arm: long head of biceps tendonitis, peri-arthritis of the shoulder, the carpal tunnel syndrome, the cubital tunnel syndrome, medial epicondylitis, cervical radiculopathy, and other soft tissue lesions.

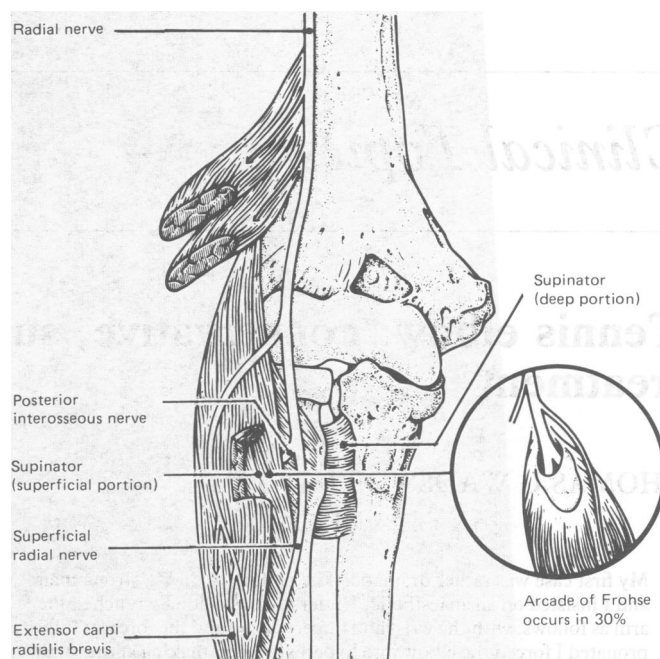


FIG 3—Arcade of Frohse at supinator muscle.

The radial tunnel syndrome and compression of the posterior interosseous nerve have been cited as causes of lateral elbow and upper forearm pain, particularly in those cases of tennis elbow not responsive to conservative treatment⁸⁻¹⁰; compressive lesions have been abnormal fibrous bands in front of the radial head, the radial recurrent fan of vessels, and the sharp tendinous origin of extensor carpi radialis brevis. Rarely, a ganglion or lipoma may cause compressive neuropathy. The posterior interosseous nerve may be compressed where it delves distally into the supinator muscle, and 30% of subjects have a well defined arcade of Frohse, which makes compression neuropathy more likely^{9 17 18} (fig 3). Pain is more diffuse in compression neuropathy than in tennis elbow, and tenderness is located in the forearm musculature distal to the lateral epicondyle, at the level of the radial head. Resisted extension of the middle finger, with the elbow extended, is an important diagnostic feature in compressive neuropathy, and pain may be elicited by resisted supination of the forearm with the elbow extended.

In my experience compression of the posterior interosseous nerve as a cause of tennis elbow is rare. A strain of the extensor musculature may be combined with typical tennis elbow. Furthermore, pain on resisted extension of the middle finger is often a feature of tennis elbow with local tenderness at the lateral humeral epicondylar origin of the extensor carpi radialis brevis.

Though compression of the posterior interosseous nerve should be borne in mind with tennis elbow resistant to conservative measures, this unusual problem can be diagnosed only, in my view, by appropriate nerve conduction studies and, in more advanced cases, by weakness of finger extension. Most good results of neurolysis can be explained by soft tissue dissection in the approach, which releases tension on the common extensor musculature.

I agree with Wadsworth and Van Rossum *et al* that, in general, the syndrome of tennis elbow cannot be explained by entrapment neuropathy.^{17 18}

Management

CONSERVATIVE MANAGEMENT

Reduced activity may result in resolution of symptoms in a few patients: this is more likely if a sling is worn for four to six weeks. Anti-inflammatory drugs and physiotherapy, particularly interferential and ultrasonic therapy, may be useful; a posterior plaster of Paris splint may be necessary in between treatments, immobilising the elbow at right angles and the forearm in neutral rotation for up to six weeks.

By far the commonest and most satisfactory treatment is injection of steroid and local anaesthetic into the tender site at the lateral humeral epicondyle; a useful combination is 0.5 ml methylprednisolone combined with 0.5 ml 2% Xylocaine mixed in one syringe (fig 4). The injection may be

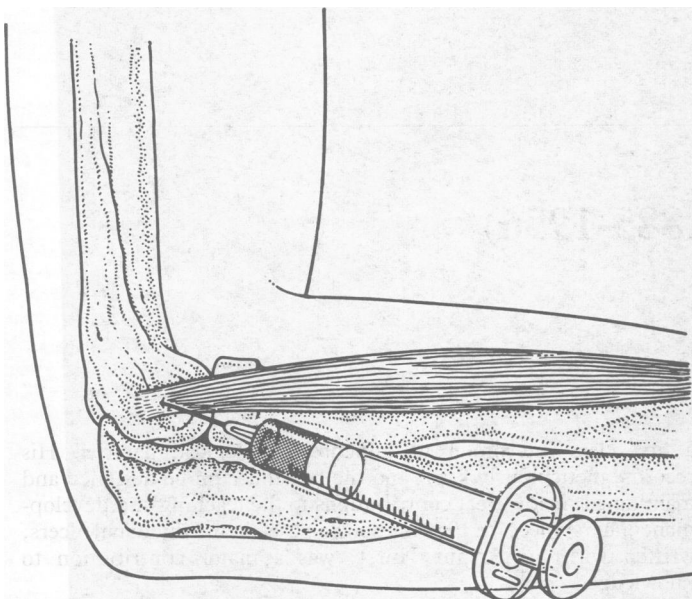


FIG 4—Injection of steroid and local anaesthetic into tendinous origin of extensor carpi radialis brevis at humeral lateral epicondyle.

repeated, for recurrence of pain, on no more than two occasions, otherwise there is a risk of necrosis of subcutaneous fat with dimpling of the skin and depigmentation, particularly in black people. After this treatment the patient should be instructed to avoid undue strain on the arm for at least three months.

RESISTANT CASES

In up to 10% of patients with tennis elbow the condition is resistant to conservative measures and provides a difficult challenge to clinicians. Various operations have been used for these cases. Several "lateral release" procedures have been described, the best known being the modified Bosworth operation.¹⁹⁻²¹ In this the common tendinous origin of the extensor musculature is released and the proximal third of annular ligament resected; if a bursa or synovial fringe is present it is excised. Success of up to 86% has been reported in a series of lateral release procedures, but a possible problem with this operation is lateral elbow instability.²²

An alternative procedure is repair, sometimes including excision of granulation tissue.^{15,16} Kaplan reported a series of cases treated by denervation with only a modicum of success.²³ Subcutaneous division of the tendinous origin of the extensor carpi radialis brevis with a small blade under local anaesthesia has been reported, with complete relief of pain in 14 of 20 patients.²⁴ Garden described an operation to release tension on the extensor carpi radialis brevis musculotendinous unit: through a lower forearm dorsal incision the distal tendon is lengthened in a Z fashion.²⁵ Savastano and Corvese reported success in a small series,²⁶ but the operation is not performed frequently and Carroll and Jorgensen reported only three good results in 16 patients.²⁷

In my experience failure of operative treatment presents a difficult problem for further management, particularly when lateral surgical release has been unsuccessful. Thus I have treated cases unresponsive to conservative measures by manipulation, using the method of Mills with the patient

fully relaxed under general anaesthesia.^{1,28} The patient is placed supine on the operating table and a mixture of 0.5 ml methylprednisolone and 0.5 ml 2% Xylocaine injected into the proximal tendon of the extensor carpi radialis brevis at the lateral epicondyle. Then the hand is grasped and the surgeon's other hand used to steady the arm above the elbow, with the forearm fully pronated and the wrist palmar flexed; the elbow is forcefully extended from the fully flexed position. Typically, there is an easily audible snap as full elbow extension is gained. The snapping sound can be attributed either to completion of a partial tear of the common extensor tendon—in effect a closed lateral release—or to breakdown of adhesions that have formed at the common extensor origin; I favour the latter explanation. The patient should be warned to avoid strain on the affected arm for at least three months.

Over the past 20 years I have treated by this manipulative method over 100 cases resistant to conservative treatment, usually injection of steroid and local anaesthetic. Repeat manipulation has been necessary in six patients, two of whom required a third manipulation. In several other patients symptoms were improved but reduced pain was experienced for several months; these cases included patients in whom surgical lateral release had failed. In one resistant case subsequent surgical release of the arcade of Frohse for posterior interosseous nerve compression, proved by nerve conduction studies, was successful.

Manipulation of the elbow under general anaesthesia for tennis elbow resistant to conservative measures can easily be performed on a day care basis. If unsuccessful the procedure can be repeated, and surgery can always be considered in the future. Manipulation after unsuccessful lateral release surgery, however, is not as successful as that after conservative measures.

It is reasonable to perform nerve conduction studies to confirm possible compression of the posterior interosseous nerve at the supinator muscle in those patients not helped by manipulation under general anaesthesia and who have heeded advice to avoid strain on the arm for three months.

Chronic medial epicondylitis—golfer's elbow—resistant to local injection of steroid is also often cured by manipulation of the elbow under general anaesthesia: with the patient relaxed the elbow is forcibly extended with the forearm held in full supination and the wrist dorsiflexed. The terminal part of the manipulation is usually accompanied by an audible snap.

Conclusion

Of the differential diagnoses of tennis elbow, the radial tunnel syndrome and entrapment neuropathy of the posterior interosseous nerve at the supinator muscle have been much emphasised. In my experience, however, features of this syndrome, said to be typical, are in fact found in many cases of tennis elbow, sometimes combined with strain of the extensor musculature in the upper forearm. Conservative management, usually injection of steroid and local anaesthetic into the tender tendinous origin of the extensor carpi radialis brevis at the lateral humeral epicondyle, is successful in 90% of cases; such injections should not be repeated on more than two occasions, and the patient should avoid straining the arm for at least three months.

In those patients not responding to conservative management manipulation under general anaesthesia, combined with injection of steroid and local anaesthetic, as for conservative management, is advised and the success rate is high. Manipulation may be repeated if necessary and does not preclude future surgical management. It results in considerable saving of hospital expenditure and loss of work and leisure activities compared with surgical procedures.

References

- 1 Mills GP. The treatment of tennis elbow. *Br Med J* 1928;ii:12-3.
- 2 Runge F. Zur Genese und Behandlung des Schreibekrampfes. *Berliner Klinische Wochenschrift* 1873;10:245-8.
- 3 Allander E. Prevalence, incidence and remission rates of some common rheumatic diseases and syndromes. *Scand J Rheumatol* 1974;3:145-53.
- 4 Gruchow HW, Pelletier BS. An epidemiologic study of tennis elbow. *Am J Sports Med* 1979;7:234-8.
- 5 Kivi P. The etiology and conservative treatment of humeral epicondylitis. *Scand J Rehabil Med* 1982;15:37-41.
- 6 Trethowan WH. Tennis elbow. *Br Med J* 1929;ii:1218-22.
- 7 Bosworth DM. The role of the orbicular ligament in tennis elbow. *J Bone Joint Surg [Am]* 1955;37:527-33.
- 8 Roles NC, Maudsley RH. Radial tunnel syndrome: resistant tennis elbow as a nerve entrapment. *J Bone Joint Surg [Br]* 1972;54:499-508.
- 9 Spinner M. The arcade of Frohse and its relationship to posterior interosseous nerve paralysis. *J Bone Joint Surg [Am]* 1968;50:809-12.
- 10 Lister GD, Belsole RB, Kleinert HE. The radial tunnel syndrome. *J Hand Surg* 1979;4:52-9.
- 11 Newman JH, Goodfellow JW. Fibrillation of radial head as one cause of tennis elbow. *Br Med J* 1975;iii:328-30.
- 12 Gunn CC, Milbrandt WE. Tennis elbow and the cervical spine. *Can Med Assoc J* 1976;114:803-9.

- 13 Huskisson EC. The arthroses and diseases and injuries of the soft tissues. In: Wadsworth TG, ed. *The elbow*. Edinburgh, London, New York: Churchill Livingstone, 1982:283-302.
- 14 Cyriax MB. The pathology and treatment of tennis elbow. *J Bone Joint Surg* 1936;18:921-5.
- 15 Coonrad RW, Hooper WR. Tennis elbow, its course, natural history, conservative and surgical management. *J Bone Joint Surg [Am]* 1973;55:1177-82.
- 16 Nirschl RP, Pettrone FA. Tennis elbow. *J Bone Joint Surg [Am]* 1979;61:832-9.
- 17 Wadsworth TG. Entrapment neuropathy in the upper limb. In: Birch R, Brooks DM, eds. *Rob and Smith's operative surgery, the hand*. 4th ed. London: Butterworth, 1984:469-86.
- 18 Van Rossum J, Buruma OJS, Kamphuisen HAC, Onvlee GJ. Tennis elbow—a radial tunnel syndrome? *J Bone Joint Surg [Br]* 1978;60:197-8.
- 19 Bosworth DM. Surgical treatment of tennis elbow. *J Bone Joint Surg [Am]* 1965;47:1533-6.
- 20 Boyd HB, McLeod AC. Tennis elbow. *J Bone Joint Surg [Am]* 1973;55:1183-7.
- 21 Posch JN, Goldberg VM, Larrey R. Extensor fasciotomy for tennis elbow. *Clin Orthop* 1978;135:179-82.
- 22 O'Neil J, Sarkar K, Uthoff HK. A retrospective study of surgically treated cases of tennis elbow. *Acta Orthop Belg* 1980;46:189-96.
- 23 Kaplan EB. Treatment of tennis elbow (epicondylitis) by denervation. *J Bone Joint Surg [Am]* 1959;41:147-51.
- 24 Murtagh JE. Tennis elbow. *Australian Family Physician* 1978;7:1307-401.
- 25 Garden RS. Tennis elbow. *J Bone Joint Surg [Br]* 1961;43:100-6.
- 26 Savastano AA, Corvese L. Experiences with the Garden operation in resistant tennis elbow. *RI Med J* 1977;60:78-9,112.
- 27 Carroll RE, Jorgensen EC. Evaluation of the Garden procedure for lateral epicondylitis. *Clin Orthop* 1968;60:201-4.
- 28 Wadsworth TG. Lateral epicondylitis (tennis elbow). *Lancet* 1972;i:959.

(Accepted 18 November 1986)

Portraits from Memory

9—Professor Matthew J Stewart (1885-1956)

JAMES HOWIE

It is as editor of the *Journal of Pathology and Bacteriology* for 22 years (1934-56) that Matthew Stewart is most likely to be remembered;



and it is probably in that role that he would most wish to be remembered. But this is an incomplete picture of the great man himself—for he was a great man—and of his essentially lovable and humorous personality. His eyes had ever a twinkle; his speech was ever adapted to his listener's ears and to the context of his story; and his general tolerance of the weaknesses and follies of his fellow humans was handsome enough to win over even those who most strongly disagreed with some of his points of

view. Moreover, his contributions to the art and science of medicine have not been fully appreciated by those who dismissed him as merely a morbid anatomist of the old school.

"Social, friendly, honest man"

From Glasgow University, where he was the most distinguished medical graduate of his year, he came to Leeds in 1910 as clinical pathologist to the General Infirmary and was soon appointed to the university staff. He was recalled from a territorial hospital in France shortly before the end of the first world war and was appointed to the chair of pathology, as he happily recalled, only by the casting vote of the chairman. Pathology at Leeds grew apace under his stimulus. He was a magnificent teacher and, although not an experimentalist,

a first class interpreter of difficult pathological material. His records, meticulously kept, and the fine museum he designed and maintained, made great contributions to the teaching and development of his subject. In 1929 his book on gastric and duodenal ulcers, written with Sir Arthur Hurst, was a major contribution to knowledge.

But it is as the perfectionist editor of the *Journal of Pathology and Bacteriology* that most will remember him, and as I best knew him. Even in 1932 when, as a mere beginner, I first met him I thought him significantly different from other distinguished seniors of the Pathological Society. There was mischief and friendliness in his eyes and an eager desire to talk to and listen to a raw beginner. In 1940 I experienced his editing of a paper which John Cruickshank and I offered to the journal. Some of his editorial suggestions John would not accept, and I had to negotiate with Matthew. When I referred to one of his changes as "mere transliteration," he laughed and embraced me.

"I see you have a feeling for words, laddie; so let it stand. Stet!"

I met him next in 1945 when he approached me with a suggestion that I might do a spell as one of his two assistant editors. The other was Professor Roy Cameron. I knew something of the work that would be entailed and I knew also that one of the other commitments I was considering would not be compatible with work for the journal. He agreed; obviously I must dismiss all idea of accepting that other commitment. This would be perfectly honourable because I could not have known when I discussed it that I was about to be invited to assist with the journal. First things must come first. I agreed to give it a try and thus entered on seven exciting and exhausting years of association with one of the liveliest characters I have known.

Nothing but the best

Devotion to the journal ruled all. He was an obsessive perfectionist. He read all published papers three times—on their submission, at galley proof stage, and in final page proof. "We don't want erratum slips hanging out like a line of washing on every issue of our journal—as on that other one!" Cameron and I had to read each other's papers in page proof as well as our own in galleys; and so everything was checked at least seven times. Stewart reported always that at least one error was spotted by only one of the three of

Edinburgh EH13 0BU
SIR JAMES HOWIE, MD, FRCP

Correspondence to: 34 Redford Avenue, Edinburgh EH13 0BU.